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THE

Journal of the Society of Arts,

AND OF

THE INSTITUTIONS IN UNION.

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Announcements by the Council.

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Institutions.

The following Institutions have been received into Union since the last announcement:—

Bessbrook (Newry), Mutual Improvement Society.
Watt Institution and Edinburgh School of Arts.

Notice to Members.

The One-Hundred-and-Twelfth Session of the Society will commence on Wednesday, the 15th inst., when the Opening Address will be delivered by Wm. Hawes, Esq., F.G.S., Chairman of the Council.

The following are the dates of the Wednesday evening meetings, the chair being taken at Eight o'clock:—

1865. November	—	—	15	22	29
„ December	6	13	20	—	
1866. January	—	—	17	24	31
„ February	7	14	21	28	
„ March..........	7	14	21	—	
„ April	4	11	18	25	
„ May............	2	9	16	23	30
„ June	—	—	—	27*	

For the Meetings previous to Christmas, the following arrangements have been made:—

November 15.—*Chairman's Opening Address.*

November 22.—"On Water Supply, especially in Rural Parishes and Districts." By J. Bailey Denton, Esq.

November 29.—"On the Proposed Purchase of Railways by the Government." By William Hawes, Esq., F.G.S.

December 6.—"On London Milk." By J. Chalmers Morton, Esq.

December 13.—"On the Graphotype, a Process for producing from Drawings, Blocks for Surface Printing." By Henry Fitz-Cook, Esq.

December 20.—"On Parkesine, its Composition, Manufacture, and Uses. By Owen Rowland, Esq.

The Cantor Lectures for the ensuing Session will consist of Three Courses, to be delivered by G. W. Hastings, Esq., LL.D., Barrister-at-law; Fleeming Jenkin, Esq., F.R.S.; and Dr. F. Crace Calvert, F.R.S.

The following are the particulars of Mr. Hastings's course:—

Lecture I.—Monday, November 27th.—"The Effects of the Discovery of the Precious Metals on the Ancient Civilisation of the Mediterranean."

Lecture II.—Monday, December 4th.—"The Effects of the Discovery of the Precious Metals on Modern Civilisation.

Lecture III.—Monday, December 11th.—"On Copyright."

Lecture IV.—Monday, December 18th.—"On Limited Liability."

The lectures will commence each evening at Eight o'clock.

These Lectures are open to Members, each of whom has the privilege of introducing one Friend to each Lecture.

Proceedings of the Society.

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CANTOR LECTURES.

"On some of the most important Chemical Discoveries made within the last Two Years." By Dr. F. Crace Calvert, F.R.S., F.C.S.

Lecture IV.

(*Continued from page 743.*)

Delivered on Tuesday, the 25th of April, 1865.

On some of the Discoveries in Agricultural Chemistry.

Before asking your especial attention to some of the most important mineral matters which exist in soils, I wish to say a few words on some of the researches published a few years since by Professor Way, in which that gentleman showed that soils had the power to retain with great tenacity certain mineral matters, which, although soluble in water, could not be removed from soils even when brought into contact with great quantities of water. He further demonstrates that if he made to percolate through a given quantity of soil certain soluble salts, such as those of soda, potash, and ammonia, these would be retained in the soil, whilst the acids with which these bases had been combined, would unite with some of the elements previously existing in the soil, pass off, and the alkalies themselves remain fixed. Thus, according to him, the retentive power of soils was due to the presence in them of a small quantity of double silicate of alumina. Thus, for instance, a double silicate of alumina and soda, when brought in contact with lime, will part with soda and take up lime; but if this silicate, in its turn, is in presence of magnesia, the lime will pass in solution and the magnesia be retained. If, then, a salt of potash is employed, the magnesia will be removed from the double silicate and the potash take its place. If ammonia be brought in contact with the above silicates, except that of potash, it will substitute itself for soda, lime, or magnesia. These valuable researches prove to farmers that they have nothing to fear as to the loss of any valuable manure, such as compounds of ammonia and potash, which they might employ as manure on their lands, even if these were drained, for the potash or ammonical salts employed by them as manures and spread on the surface, would not pass off in the drainings of the land, but be retained by the soil under the form of a double silicate until required by plants, and decomposed under the influence of that mild but still all-powerful force called vitality. The researches of Professor Way have been extended by those of Dr. Voelcker, who, instead of employing simple salts, employed complicated liquids on various classes of soils, namely, calcareous clay soils, and ferruginous, sterile, sandy soils, and obtained the following results:—

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* The Annual General Meeting: the Chair will be taken at Four o'clock. No Visitors are admitted to this Meeting.

1. That the calcareous clay soil absorbs about six times as much ammonia from the liquid manure, as the sterile sandy soil.
2. That the liquid manure in contact with the calcareous clay soil becomes much richer in lime; whilst during its passage through the sandy soil, it becomes poorer in lime.
3. That the calcareous soil absorbs much more potash than the sandy soil.
4. That chloride of sodium, in conformity with the results of other observers, was not absorbed to any extent by either soil.
5. That both soils removed from the liquid most of the phosphoric acid.
6. That the liquid in passing through the calcareous soil becomes poorer; and, on the other hand, in passing through the sandy soil becomes richer in soluble silica.

These researches of Dr. Voelcker led him to a somewhat different conclusion to that adopted by Professor Way. He does not think that the silicates of ammonia and magnesia that exist in soils, have all the retentive power attributed to them by Professor Way, but that potash and ammonia are retained in soils by the peroxide of iron and alumina which they contain, acting as weak acids with respect to the alkalis. He also considers that it is the same oxides which act as fixing agents of the phosphoric acid that may be added on soils as manure, under the form of super-phosphate of lime, or similar compounds. The researches of P. Thenard, Way, and Voelcker, point to the interesting fact that some of the most apparently useless elements in soils, such as alumina, oxide of iron, &c., are in reality the most useful, for although they do not take an active part in promoting vegetation, still they are the medium by which essential substances, such as fumic acid, phosphoric acid, potash, and ammonia, are retained and stored in soils until required to promote growth and vegetation.

Before drawing your attention to a few of the substances that a soil should contain, not only to enable it to support vegetation but to promote it in a high degree, I deem it my duty first to give here a few tables which shall give you an idea of the various mineral matters which chemists have found to exist more or less abundantly in vegetables, and which are found to compose the ashes left by vegetable matters when incinerated. The first table gives the amount of mineral matters in a thousand parts of many of our ordinary agricultural products:—

Mineral Matters in Plants in 1,000 Parts.

Wheat, about	20
Barley	30
Oats	40
Rye	20
Maize	15
Beans	30
Peas	30
Potatoes	8 to 15
Turnips	5 to 8
Carrots	15 to 20
Wheat straw	50
Barley straw	50
Oat straw	60
Rye straw	40
Meadow hay	50 to 100
Clover hay	90
Ryegrass hay	95

The second table gives you an outline of the relative proportions of some of the most important mineral substances existing, in the ashes of several of the commonest cereals and roots cultivated by our farmers:—

Mineral Matters in Plants.

	Wheat.	Barley.	Oats.	Rye.	Potatoes.	Turnips.
Potash	237	136	262	220	557	419
Soda	91	81	—	116	18	51
Lime	28	26	60	49	20	136
Magnesia	120	75	100	103	52	53
Oxide of iron	7	15	4	13	5	13
Phosphoric acid	500	390	438	495	125	76
Sulphuric acid	3	1	105	9	136	136
Silica	12	273	27	4	42	79
Chlorine	—	traces.	3	—	42	36
	998	997	999	1,009	997	999

These tables naturally point out the great variety of mineral matters that enter into the composition of the ashes of plants, and also will familiarise your minds with the important relations which some of those minerals have to the growth of plants which contain them. But before adverting to the part which some of these minerals play in vegetation, it is desirable that I should refer to the relative quantities of mineral matters taken from the soil where they are grown, in what is called by farmers a rotation of crops.

Rotation of Crops.—Quantity of Produce Removed from One Acre of Ground.

				lbs.
1st year	—Turnips	Bulbs		51,000
		Tops		14,000
2nd „	—Barley	Grain		2,116
		Straw		2,040
3rd „	Clover			2,030
	Ryegrass			2,060
4th „	—Wheat	Grain		920
		Straw		3,570
				77,736
	Moisture		19,230	
	Mineral		1,284	
				20,514
	Organic			57,222

Although these tables illustrate the quantity of the mineral matters, their variety, and relative proportions existing in plants, and lastly the total amount of the various minerals which a rotation of crops removes from the soil, still they do not point out to you which are the most essential to vegetation. Perhaps the word "essential" which I have just used, is not correct, for all the mineral matters found in a plant must be essential to its existence and to its growth; but some of these minerals exist, generally speaking, in soils, and that in sufficient quantities for the wholesome growth of the plant; others are in minute quantities, and they are soon removed by successive crops, and if the mineral elements which compose that soil, cannot by their decay or chemical decomposition set free, or bring into fit condition for the coming crop, these peculiar, rare, and still essential elements of vegetation, the soil will not reproduce the crops which require for their production those peculiar mineral substances. For example, a sufficient quantity of phosphates for turnips, or a sufficient quantity of potash for mangolds, or a sufficient quantity of silicates and phosphates for wheat and other graminous plants. It, therefore, becomes necessary that I should dwell for a few minutes on some of the most important mineral substances that should exist in the soil for peculiar crops, or should be added to it as a manure if that soil is not exhausted of those treasures of vegetation.

The first substance belonging to this class to which I desire to draw your attention is phosphorus. It is only within the last fifteen or twenty years that the importance of phosphorus to vegetation has been demonstrated. Although experience had led certain farmers to the knowledge that phosphates—for example, ground bones—would promote the growth of meadow lands, still the honour is due to Liebig not only of having pointed out but proved the importance of phosphorus, or rather of phosphates, as essential elements of the rapid growth of plants, and especially of roots, for he was the first to call the attention of the agricultural world to the benefits to be derived, if, instead of using phosphate of lime in its insoluble state as it exists in bones,* it was added to soils either in a soluble condition, or in one which might easily become so under the influence of certain agents to which I shall hereafter refer. It is since the publication of his ideas that we have had the researches of Boussingault, Lawes, Dr. Gilbert, Dr. Voelcker, and Ville, who have shown on the one hand the importance of phosphates to vegetation, and on the other the extremely small quantities which exist naturally in soils; for chemists have been able to discover only traces of phosphoric acid in ordinarily cultivated soils, and these minute quantities had been traced as existing in primitive rocks forming those soils; and, although I am quite ready to admit that agricultural chemistry is still in its infancy, and can at the present time give only here and there useful information to the farmer, or insights into certain phenomena which take place in agriculture, still it cannot be denied that when we consider that it is only within the last twenty or thirty years that chemistry has really attempted to unravel the mysteries attending vegetation, and also to give a clear and scientific explanation of facts which hundreds of years have revealed to man, we cannot deny that in pursuing the same course for a hundred years, most invaluable and enlightened information will be thrown upon agriculture, and instead of being the result of mere experience, which often leads to failures, the farmer will base his operations on sound and scientific principles, which will enable him to obtain from his land the full yield it is capable of producing. The best proof of the correctness of this statement is that in England, where chemical agriculture has made the greatest advance, farmers as a rule have ceased to allow the land to lie fallow—an operation which had for its object to allow the atmosphere to act upon the mineral elements of the land, so as to modify them in such a way as to liberate some of the scarce and still essential elements of vegetation, such as potash and phosphoric acid. In fact, so true is the rapid removal of phosphoric acid from what we call fertile land and its importance to the successful rotation of crops now adopted by most of the intelligent farmers of this country, that not only are bones imported from Australia, South America, and the Continent, but even minerals, such as apitite, are imported from Norway, and phosphorite from Estremadura, in Spain, and also under the form of semi-fossilized guano, under the names of Lambrero and Kooria Mooria guanos. But even these abundant sources of phosphoric acid do not appear to be sufficient to supply the large demand that there is at the present day for phosphates or super-phosphates for agricultural purposes, for large quantities of fossilized coprolites abundantly found in Cambridgeshire, Suffolk, and Bedfordshire are used especially under the name of super-phosphate of lime. As to the mode in which they are treated to produce the valuable agricultural manure (super-phosphate of lime) I must refer you to the first lecture which I had the honour to deliver before you last year, in which also you will find the proportions of such super-phosphates of lime, the average composition of which I shall take the liberty of repeating here:—

Soluble phosphate	22	to	25	per cent.
Insoluble ,,	8	,,	10	,,
Water	10	,,	12	,,
Sulphate of lime	35	,,	45	,,
Organic matter	12	,,	15	,,

Nitrogen 0·75 to 1·5 per cent.

Although super-phosphate of lime is a soluble salt when added by the farmer on the surface of his land either dissolved in water or in the state of a powder, still this solubility must rapidly disappear when in contact with the soil, for the soluble phosphate of lime is due to the excess of phosphoric acid which it contains, and the excess disappears when in contact with the soil as it meets, generally speaking, carbonate of lime or of magnesia, or oxide of iron which neutralise the excess of acid, rendering thereby the remaining portions of phosphate of lime insoluble. It, therefore, becomes interesting to inquire how an insoluble substance becomes soluble to render it fit to be absorbed by the spongioles or the roots of plants so as to convey it into the plants themselves. This is effected by carbonic acid gas dissolved in water which penetrates into soils, or by the fumic acid discovered in soils by Thenard, or by a non-neutral substance, similar in its composition to sugar, which has also the power of rendering soluble the insoluble phosphates existing naturally in the soil or added to it by the hand of man.

Dr. Voelcker published in 1863, in the Memoirs of the Royal Agricultural Society, a most valuable paper on the absorption of phosphate of lime and phosphatic manures by root crops. Among the many facts which had a direct interest for those employed in the cultivation of the soil, there is one point connected with these researches to which I desire to call your attention, and that is the relative amount of phosphoric acid which is required by an average crop of wheat or of turnips per acre. You may observe in reading over the following table that whilst turnips require 39¾lbs. of phosphoric acid, wheat, which is considered a highly nitrogenated crop, only contains 25¾lbs. of the same substance. This statement is correct so long as you take the total weight of the crop produced by an acre of land, for one acre of land will produce 20 tons of turnips and about two tons of wheat; but if you take 100lbs. of each of these substances, then, of course, wheat will contain a far larger proportion of phosphoric acid than the turnips:—

---

* The general composition of bones may be considered to be as follows:—

Bones.

Organic Substances.	Blood-vessels	1
	Osseine	32
	Fatty matters	9
Mineral Substances.	Water	8
	Phosphate of lime	38
	Phosphate of magnesia	2
	Carbonate of lime	8
	Divers salts	2
		100

ONE ACRE OF LAND.

	20 TONS OF TURNIPS.		WHEAT.	
	Bulbs.	Tops.	Grain. 1,920 lbs.	Straw. 3,840 lbs.
	lbs.	lbs.	lbs.	lbs.
Potash	132·	45·5	9·75	25·
Soda	6·25	7·	—	—
Magnesia	6·25	2·25	3·75	3·75
Lime	36·	68·5	1·	10·5
Phosphoric acid	28·25	11·5	16·25	9·5
Sulphuric acid	36·	25·	·25	5·25
Silica	3·	2·25	1·	128·75
Chloride of sodium	19·	18·25	·5	9·25
Chloride of potassium	—	11·5		
Carbonic acid	47·25	36·25	—	—
	314·00	228·00	32·5	192·00

The researches of Mr. Lawes and Dr. Gilbert have demonstrated thoroughly the truth that the employment of super-phosphate of lime as a manure is useful for promoting the growth of wheat, and is essential to the perfect success of a crop of turnips. M. Ville has also published important papers in the "Comptes Rendus of the Academy in Paris," on "The influence of phosphates on vegetation;" and the following table will, I hope, convince you of the marked influence which they exercise on vegetation:—

INFLUENCE OF PHOSPHATES ON VEGETATION.

Phosphate of lime Alkaline silicates	20·86
Phosphate of lime	18·80
Earths and alkaline silicates	0·60
Earths	1·84

But the most interesting data at which M. Ville has arrived consist in that the presence of phosphates in soils determines a corresponding absorption of nitrogenated compounds by the plant; that is to say, that if phosphates are supplied to a vegetable, its growth will be partial; and if, on the other hand, ammoniacal salts or nitrates are supplied to it the growth will be imperfect; but if both of them be added to the soil, the absorption of the phosphate will be increased as well as that of the ammonia. This result is most interesting, not only in an agricultural point of view, but also as a physiological fact, for, until this important observation of M. Ville, scientific men had merely studied the immediate influence or absorption which the substance had on the vegetable or animal, without taking into account how these phenomena might be modified by the presence of others. I look upon the observation of M. Ville as one which will ultimately be far more appreciated than it appears to have been, and one which will lead to most important results in animal physiology and agriculture. I shall conclude these observations by giving you a table published by M. Ville, and which clearly sets forth the truth of these remarks:—

AMOUNT OF NITROGEN FIXED BY WHEAT UNDER THE INFLUENCE OF THE FOLLOWING SALTS:—

	Without Nitrogenated compounds.	With Nitrogenated compounds.
Phosphate of Lime and Alkaline Silicate	8·15	20·08
Phosphate of Lime	7·25	19·17
Earths and Alkaline Silicates	5·71	11·16
Earth	3·00	9·50

The extraordinary liberality with which the Emperor of the French has supported and encouraged all scientific researches or inventions which might tend to promote the welfare of his subjects, is exemplified in the case of M. Ville, for the Emperor has not only built a special laboratory for his use, and placed a large greenhouse and other means of investigation at his disposal, but has also allowed him to experiment on one of his private farms. And this encouragement has not been lost, for M. Ville has arrived at some very valuable and practical results. Admitting that he wishes to ascertain what the soil is deficient in, so as to produce a full crop, he divides, say an acre of land into four parts—adds to one portion superphosphate of lime; to another portion carbonate of potash; to another portion caustic lime; and lastly, nitrate of soda. He then places on these sections of the acre the various crops which are intended to be grown, and he soon finds out which of the four manures should be added to convert an ordinary yielding field into an abundant one. This simple and practical mode of proceeding has led him to use, as a general manure, which he calls mineral manure, the following substances:—Phosphate of lime, 4 parts; carbonate of potash, 4 parts; caustic lime, 1·5 parts; and nitrate of soda, 6·5 parts. The results have been most satisfactory, and among the many he has published during the last two or three years I shall simply give the following:—

TOTAL CORN PER ACRE.

Unmanured	990	926
Mixed mineral manure	1192	987
Ammonia salts	1471	1618
Mixed mineral manures and Ammonia salts	2407	2295

STRAW AND CHAFF PER ACRE.

Unmanured	1625	1459
Mixed mineral manure	1804	1528
Ammonia salts	2536	2705
Mixed mineral manure and Ammonia salts	4176	4016

Allow me to pass from these highly-interesting and practical results obtained by M. Ville to those not less valuable published by Dr. Voelcker on another mineral matter which, like phosphoric acid, is only found in small quantities as a natural product in soils, and which, if absent, like phosphoric acid, renders the soil unprofitable to the farmer. That substance is potash. Dr. Voelcker has not only studied the action of one compound of potassium, say the caustic or carbonate of potash, but he has examined the action of these and also of sulphate of potash, chloride of potassium, and nitrate of potash, and to enable him to arrive at the correct result he had compared the action of these different salts of potash on various classes of soils, namely, calcareous stiff clay, fertile sandy loam, pasture land, marly soil, and sterile sand; and he has come to the general conclusion that when salts of potash are added to these soils, although the quantity retained by them varies with the nature of the compound of potassium used or the nature of the soil operated upon, still the soil will retain the potash and not allow it to pass off in the water which may issue from it by drainage or otherwise. If he employs a salt of potash, say the nitrate, sulphate, or chloride, the sulphuric acid, the nitric acid, or the chlorine will combine with the lime or the magnesia, and even in some instances with the ammonia which the soil may contain, while the potash will substitute itself to either of these bases which were in the silicate, demonstrated to exist in soils by Professor Way.

As mankind increase on the surface of the globe, and their wants proportionately become greater, so by a marvellous and admirable dispensation of Providence, the power of the production of the soil to meet the wants of man is developed. A striking instance of this is given in the application of chemical discoveries to the cultivation of the land to make it commensurate with the growing requirements of the people. Thus, for example, we find stored in various parts of England—Suffolk, Cambridgeshire, and Bedfordshire—large beds of coprolites, or the refuse of antediluvian animals buried there for thousands of years, unknown to man, and its value unappreciated. Further, chemists have discovered in Norway mountains of phosphate, under the form of apitite, and tracts of land of phosphorite in Estremadura in Spain. The same remarks applies with equal force and truth to salts of potash. Their supply up to the present time has been limited, as I stated to you in my last lecture, in speaking of the discoveries of M. Ballard, whose name I mentioned with no undue praise, as showing the benefits which society may derive from the extraction of a double chloride of potassium and magnesium from the ocean. Strange to say, within the last few years this identical salt has been discovered in large quantities as a mineral at Stassfurth, in Saxony, and although this mineral exists as a stratum under beds of ordinary common salt, and its discovery dates only three years back, there are at the present time 14,000 men employed in the factories which have risen on the spot for the extraction of the salt from its mineral, and its conversion into the various products required by the trade. This mineral, which has been called carnallit, and which assumes a thickness of 1,000, is composed in 100 parts, as follows:—Chloride of magnesium, 31·46; chloride of potassium, 24·24; chloride of sodium, 5·10; chloride of calcium, 2·62; salt of lime, 0.84; oxide of iron, 0.14; and water, 35·37. It may be considered as a definite chemical compound of 1 equivalent of chloride of potassium; 2 equivalents of chloride of magnesium; and 12 of water. I have not the slightest doubt that when this important discovery becomes generally known to our salt manufacturers, they will also turn their attention to the nature of the minerals composing the sub-soils of their salt beds, and will discover cannallit, and thus confer on the country a great boon by promoting its agriculture. The popularising of this fact may confer a great benefit on those salt-mine proprietors who are working their mines for rock salt, and who have not filled their mines with water, so as to take from them a brine containing the salt they require. I have no doubt that if cannallit is discovered in England, it will in many instances modify entirely the present method of working salt mines.

Lime.—Too much importance cannot be attached to the presence in certain proportions of lime in soils, for it is one of the essential elements of ashes of plants, and is necessary to their growth. In fact, Dr. Voelcker says:—

"We know practically how essential the presence of lime is for the healthy growth of every kind of cultivated produce. On soils very deficient in lime, most crops, especially green crops, are subject to all kinds of disease; and, consequently, roots fail altogether on such land, even if it has been liberally manured with good yard dung or guano. Up to a certain stage, corn and roots grown under such conditions appear to thrive well, but as the season advances they sustain a check, and at harvest time yield a miserable return. The remedy for such failures, which are not at all uncommon in localities where poor sandy soils prevail, is a good dose of lime or marl, and then, and only then, farmyard manure or guano may be applied to the greatest advantage. Marl or lime alone does not suffice for meeting all the requirements of our cultivated crops on such poor sands, and though calcareous minerals supply a most necessary element of plant-food, and by acting on the latent stores of food in the soil, produce at first a most strikingly favourable effect upon vegetation, they soon fail to produce the desired effect if repeated too often, to the exclusion of other fertilising matters. On the other hand, the most liberal application of farmyard manure of the best quality never produces so beneficial and lasting an effect on poor sandy soils as when they have been previously well marled or limed. On such land no doubt the proverb holds good:

"Lime and marl without manure
Only make the farmer poor."

"But at the same time I have a strong impression that on such land manure, without lime or marl, does not help much towards paying the rent. There are some soils which swallow up manure, with, so to speak, an insatiable appetite, without ever feeling the better for the manure; they are appropriately called very hungry. On all such soils I have no hesitation in saying much manure is wasted, or the most is not made of it, if previously to the application of farmyard-manure, guano, &c., the land has not received a good dose of marl or lime.

"My recent filtration experiments point out the reason why marl or lime is peculiarly valuable on poor sands. It is not merely by supplying in a direct manner a deficient element of nutrition that lime acts so beneficially on such soils, but because it preserves in the soil the more valuable fertilizing matters, which, like salts of potash or ammonia, rapidly filter through sandy soils, unless a sufficient quantity of marl or lime has been previously applied to the land. By these means the bases of the more valuable saline soluble constituents of rotten dung or of guano are retained in the soil, whilst the acids filter through it in combination with lime, a constituent which is, comparatively speaking, inexpensive."

The evening is too far spent for me to attempt to enter into the valuable researches of Mr. Lawes and Dr. Gilbert connected with meadow lands and the feeding of cattle; but I would strongly recommend those who take an interest in these branches of science to consult the papers published by those gentlemen in the *Journal of the Royal Agricultural Society*. I would also call your attention to a paper on the same subject by Mr. John Coleman, as well as a talented lecture which that gentleman delivered a few weeks since before this Society, in which he gives most important information to the farmer respecting the cheap feeding of cattle.

I hope, ladies and gentlemen, that you are now convinced of the truth of the assertion which I made at the beginning of this lecture, that no country possesses men better informed than those who exist in England on scientific agriculture. In fact, we can boast, especially if we give the lead to Scotch farmers, of being the leading nation in point of agricultural progress.

Lecture V.

Delivered on Tuesday, the 9th May, 1865.

On the Discoveries in the Chemistry of Rocks and Minerals.

Although the title of this lecture appears to have some reference to the lectures recently delivered by my learned predecessor, Professor Ansted, still the study of geology and mineralogy is so vast that different men may lecture on them without interfering with one another's views, or in the slightest degree with the special branch of that science that each one has chosen for his discourse.

The first subject to which I should wish to draw your attention is the origin of colour in minerals. Up to a very recent period it was generally believed that their colour was due to a minute quantity of certain metallic oxides diffused through the mass; thus the red colour of the garnet was attributed to sesquioxide of iron; ultramarine to oxide of cobalt; emerald to sesquioxide of chromium; and amethyst to oxide of manganese.

The first researches which were published, according to my knowledge, on the fact that organic matters might exist in minerals, are due to Sir David Brewster, who discovered in one of the most compact and hard minerals known, viz., topaz, exceedingly volatile hydrocarbons, which were so volatile that the simple heat of the hand, when brought to bear upon this mineral, proved sufficient to transform them into gaseous matters, which would recondense on the hand being removed. Sir David Brewster ascertained that the fluids were confined in small apertures, or cells, existing in the mineral, and calculated there were 3,000 cavities in one-seventh of an inch of topaz. In 1857 Lewy ascertained that the green colour of the emeralds of Muso, New Grenada, was not due to sesquioxide of chromium but to an organic substance, for not only did they yield water and carbonic acid when heated in a close vessel, but on calcining a small quantity of the mineral it became colourless, and did not again resume its primitive colour, which probably would have been the case if the colour of the mineral had been due to sesquioxide of chromium. Notwithstanding this, Mitscherlich and Rosé published, in 1864, a paper in which they showed that the colour of a certain class of emeralds was due in their opinion to the presence of this oxide.

Knox also demonstrated the fact that smoked quartz became colourless when heated; and Kühlmann, in researches recently published, has shown that smoked quartz will lose its colour under the influence of heat, and that the blueish black colour of flint may be traced to the same cause.

Wolf proved some time since that the various colours which fluor-spar assumes are also due to organic substances; and his researches leave no doubt that the colour of green fluor-spar can be traced to a hydrocarbon. But one of the most interesting papers published of late on this subject is that of Professor Fournet, of Lyons, in which he shows that the reddish, yellowish, or greenish colour which some clays assume is not due, as was formerly believed, to metallic oxides, but may clearly be traced, in many instances, to the presence of organic substances.

Amongst numerous instances that he cites in his memoirs, the most curious one is the molecular change of certain clays into a mineral called jasper, " a double silicate of alumina and protoxide of iron," and which conversion could not be attributed to the action of heat, but to the slow dehydration of the clay and to pressure, for he was able to trace in those splendid veins of jasper existing in the province of Constantine, Algeria, the gradual passage of certain beds of clay into corresponding ones of jasper, and this mineral as well as the clay from which it was produced, became not only colourless under the influence of heat, but gave off vapours which had a strong empyreumatic or organic odour. Mr. F. Kuhlman, whose name I have often had the pleasure of citing in this course of lectures, has published of late in the Comptes Rendus of the Academy of Sciences of Paris, several papers on the interesting subject as to what the colouration of minerals is attributable to, and this gentleman has not only proved that in many instances the colouration of certain minerals and gems may be traced to the presence of organic matters, but he has succeeded in colouring certain colourless minerals; thus, for example, by plunging into melted pitch topaz, rock-crystal, and opal, and allowing a sufficient quantity of pitch to penetrate, he has given a yellow colour to the topaz and opal, and transformed white rock crystal into the smoky variety. This fact is not only interesting to a geologist, but must prove so to every reflecting mind, for it is difficult to conceive how substances so hard and compact can prove sufficiently porous to admit the vapours of volatile bodies. His researches have also for chemists a marked interest, for he has made the following curious observation, viz., that if he took plaster of Paris, mixed with a sufficient proportion of water to convert it into a solid mass (the composition of which is equal to $S\,O_3\,Ca\,O + 2\,HO$, or sulphate of lime, with two equivalents of water), and plunged it into a bath of melted pitch, the two equivalents of water would be replaced by an equal weight of pitch, converting the whole into a solid mass susceptible of taking a high polish, and therefore applicable to many ornamental purposes. He also proposes what I believe has been in practice now in England for some time, viz., dipping bricks, and other building materials, into melted pitch, and cementing them with that substance in all cases where an impermeable wall or surface is required.

Without entering into the numerous applications of Mr. Kuhlmann's researches, I cannot part with them without citing a simple method which he proposes to determine whether the colouration of a mineral or a gem is due to an organic or to an inorganic substance. To effect this he places a small quantity of the mineral in a small platinum tube, and passes over it hydrofluoric acid, which does not affect the colour of the gem if it is due to an organic substance, for example, those of the amethyst, ruby, black diamond, or yellow quartz, but discolours at once cornelian stones, their colouring substance being sesquioxide of iron, or a silicate of it.

Allow me to mention a most interesting, and as yet little known, class of minerals, the composition of which is not only interesting to chemists but also to astronomers, mineralogists, and natural philosophers; I mean aerolites. Notwithstanding the careful analyses that have been made of these meteoric stones, the presence of no new metal has been discovered in them, or of any which chemists have not found upon our own planet; but they have been able to ascertain that some of these aerolites contain, or are composed in some instances of, metals in a native state, which are never found in that condition upon our planet; thus it has been proved that some of them contain metallic nickel, cobalt, and even iron; in fact, in some instances, the volume of some of these aerolites that have fallen on our planet, which are composed of iron, has been sufficient to allow man to work them directly into implements; such was the case with an aerolite found in Mexico, which had the following composition:—

Iron	96·50
Nickel	3·50
	100·00

What in a scientific point of view enhances the value of this peculiar class of meteoric stones, is the presence in some of them of a peculiar yellow mineral, having a great resemblance to pyrites, but still differing entirely from it in composition, as proved by the analysis of Mr. Lawrence Smyth, who found it to be composed of four equivalents of iron, two equivalents of nickel, and one equivalent of phosphorus, and to it he gave the name of " schreebersite." It has lately been artificially produced by Mr. Faye, under the able guidance of Henry St. Claire Deville, by melting together in a crucible a mixture of oxides of iron and nickel, phosphate of soda, silica, and charcoal, allowing the whole to cool, when in the fused mass were found well-defined crystals, having a yellow colour, and identical in composition to the " schreebersite" analysed by Mr. Lawrence Smyth—a triumph of science, for it is the first example of the artificial production of a mineral substance found in an aerolite. The presence of a large proportion of metallic iron, and especially of phosphorus, in this class of aerolites, proves that they must have a cosmical origin, and that they must have been formed, or rather the mass from which they have been detached, must have been produced and existed where there was no atmosphere similar to that which surrounds our planet, viz., one containing oxygen. What tends to confirm this view is that many of the meteoric stones analysed by chemists contain a large quantity of carbonaceous matters. The most complete analysis of this class of meteoric stones is that made by Mr. Cloez of one which fell in June, 1864, at Orgueil, in the south of France, and which drew the attention of many scientific men at the time, owing to its fall being clearly traced, and specimens carefully secured; it had the following composition:—

Composition of the Orgueil Aerolite.

Hygrometric water	5·975
Silicic acid	24·475
Sulphuric acid	2·195
Sulphur	4·369
Chlorine	0·073
Phosphorus	traces.
Alumina	1·175

Oxide of chromium	0·025
Peroxide of iron	13·324
Protoxide of iron	17·924
Oxide of nickel	2·450
Oxide of cobalt	0·085
Oxide of manganese	1·805
Magnesia	8·163
Lime	2·183
Soda	1·244
Potash	0·307
Ammonia	0·098
Humin	6·027
Combined water	7·345
	96·442

This analysis of Mr. Cloez is not only interesting as showing the numerous substances which enter into the composition of one of these meteoric stones, but especially owing to the fact that he demonstrated in it the presence of an organic substance similar to coal, and also water. Chemists have also ascertained that many meteoric stones are highly siliceous, or composed almost entirely of silica or silicates of various metals. Mr. Charles Sorby, of the Royal Society, has recently published, in the *Proceedings* of that Society, some interesting papers on the microscopic differences which exist between the general texture or appearance presented by meteoric stones and the lava of volcanoes; also between the native meteoric iron and the commercial kinds. There can be no doubt that these researches will throw much light on the circumstances that have attended the formation of aerolites in general. At all events there can be no doubt that fire-balls, falling stars, and meteoric stones have a cosmical origin, and that they fall on the surface of our planet whenever they come within the earth's attraction, or that this force overpowers that of the sun. It is easy to explain, knowing, as we now do, their composition, why they appear luminous when they arrive near the earth's surface, for they have to traverse an oxidising atmosphere, or one containing oxygen, and as they travel through the space heat is generated by the friction of the particles composing them with those of the atmosphere, and the heat thus produced becomes sufficient for the combustible matters which enter into their composition, viz., carbon, iron, nickel, &c., being burnt or oxidised by the oxygen of the atmosphere. It is the knowledge of this fact which, no doubt, has suggested to Professor William Thomson his theory—that the high temperature of the sun is due to, and maintained by, the heat generated by cosmical matter falling on its surface, as I had the pleasure of explaining to you more fully in my first lecture.

I shall now examine with you the artificial formation of certain minerals and gems. Some of the earliest and most successful attempts in this line of researches are those of that talented chemist, Abelman, who made the curious observation that certain bodies or compounds, which chemists had considered as fixed or non-volatile, were susceptible of being volatilized if they were kept at a very high temperature for a long period, and also that bodies might be made to combine together and form certain minerals which existed already in nature. The fusible and volatile substance which he especially used was boracic acid; thus he mixed with a large quantity of this substance small amounts, but in equivalent proportions, of alumina and magnesia, and introduced the whole into a crucible which was placed in a porcelain kiln, and submitted to an intense heat for several days, when the greatest part of the boracic acid was volatilized; on allowing the fused mass to cool, well-defined crystals were found which, on examination, proved to be identical with the mineral called spinelle ruby, and by substituting the earth called glucina for magnesia, he obtained another gem called "cymosplane." Without adverting to the various mimerals and gems that he produced, I may state that his researches attracted much attention at the time they were published.

M. Daubray has also succeeded in producing artificially various minerals by submitting, in a boiler containing water, divers amorphous mineral matters to an extremely high pressure, and consequently to a comparatively elevated temperature, thus converting them into crystalline ones. By this means he succeeded in producing, among other minerals, crystallised quartz.

But certainly the most interesting papers that have been published in this line of investigation are those due to a gentleman whose name I have often cited in these lectures, I mean Henry St. Claire Deville. This gentleman has succeeded in converting amorphous bodies into well-known crystalline minerals by submitting them to the influence of minute quantities of another substance, under circumstances quite novel in themselves; and what enhances the value of his researches is, that the methods he has employed are similar to those which must have taken place in nature, and also the fact that the substance which he has employed to effect the change of an amorphous substance into a crystalline one, does not itself undergo any molecular change or decomposition. For example, he has transformed the red, amorphous, sesquioxide of iron into the crystalline variety called "oligiste iron ore," identical with that found in the Isle of Elba, or into specular iron ore, similar to that observed in the craters of volcanoes. To obtain these results he places the sesquioxide of iron in a porcelain tube, and whilst the whole is heated to dull redness, he passes over it a slow current of hydrochloric acid gas. This result explains how specular iron is found in volcanoes, for his brother and Dr. Daubeny have proved the existence of hydrochloric acid among the gaseous products escaping from these great natural furnaces, in which violent chemical reactions take place. Mr. H. Deville has also succeeded in converting a mixture of sesquioxide of iron and magnesia by means of a small quantity of hydrochloric acid or what he calls his "mineralisator," into a substance called "periclase," also found on Mount Vesuvius. These results are certainly extraordinary in a chemical point of view, if we remember with what facility these oxides dissolve in hydrochloric acid when brought into contact with an excess of that gas, even when operating under the circumstances in which he did, or when these oxides are placed in contact with a solution of the same acid. Mr. H. Deville also succeeded in producing "Haussmannite," or the crystallized sesquioxide of manganese, by substituting this oxide for sesquioxide of iron in the tube in which he operated. He further observed that if he employed binoxide of manganese instead of sesquioxide of manganese, he obtained, strange to say, beautiful green crystals of protoxide of manganese. But, certainly, the most important result arrived at was the artificial formation of a mineral called "staurotide," a silicate of alumina, a mineral that exists abundantly in nature. To effect this he introduced into a porcelain tube, placed vertically, first, a layer of alumina, then a layer of silica, over this a layer of alumina, and again a layer of silica, and so on until he filled his tube, ending with silica; he then applied a gentle heat to the tube, and passed through it a slow current of fluoride of silicon, which, on coming in contact with the alumina, gave rise to silicate of alumina, and fluoride of aluminium, which, in its turn, coming in contact with silica gave rise again to silicate of alumina and fluoride of silicon, and this chemical reaction continued from layer to layer until the whole mass in the tube was transformed into "staurotide," the same mineralising substance escaping from the tube as had entered it, although during its passage it had converted the amorphous alumina and silica into the well defined mineral called "staurotide."

Mr. Deville calls the attention of mineralogists as well as chemists to the probability that such similar actions have no doubt taken place in nature, and so gives an easy explanation of many of the facts observed by geologists.

In conclusion, I may state that Messrs. Deville and Daubray have succeeded by the same method in producing anatase, rutile, and brookite.

Mr. Kuhlmann has also published in the *Comptes Rendus* of the Academy of Science of Paris, several papers on the artificial formation of minerals, and although I drew your attention on several occasions to instances of their being produced under what he calls the crystallogenic force, in my first lecture, still I cannot refrain from adverting to another example, viz., that if gummy matter be mixed with syrup of sugar, and the whole dried rather rapidly, an amorphous varnish is left, say on the surface of a glass plate, but if then it is exposed to a damp atmosphere, after a few days, the whole of the surface becomes covered with well-defined crystals of sugar.

Mr. Faraday and Mr. Becquerel, sen., published, many years ago, some valuable papers, in which they showed that, by submitting proper metallic solutions to the influence of slow currents of electricity, slowly but surely, well defined mineralogical specimens would be produced, such as gypsum, pyrites, blende, galena, and several metallic oxides.

These researches present a peculiar interest when we consider the formation of the metallic veins or lodes on our planet, the more so that Mr. Becquerel employed moistened clay to separate the two different fluids in his tubes, as a substitute for porous cells in ordinary galvanic batteries, thereby imitating nature in many instances where metallic lodes are found; thus in Cornwall, often a clay slate called killas is found to accompany or to line the lodes of tin and copper, which no doubt fulfils, as in the experiments of Mr. Becquerel, the functions which a porous cell does in ordinary batteries.

That electricity must play an important part in the formation of metallic veins or lodes, there can be no doubt, if we reflect on the advantage taken by telegraphic engineers of the earth as a conducting medium for the return current of electricity, for, as you are aware, there is no necessity to employ more than one wire, since the earth completes the circuit, thus dispensing with the use of a second one, as it brings back the current to the instrument from which it has been emitted.

Further, many practical mining engineers have observed that the veins or lodes of tin and copper run or strike in Cornwall in an easterly and westerly direction, whilst those of lead, called " cross-courses," have a bearing nearly at right angles. I am aware that there are exceptions to this rule, but they are rare. A further proof that natural electricity must play an important part in the formation of veins or lodes, is that the largest deposits are generally found near the junction of two veins. Also that metallic veins are generally mixed with mineral matters differing entirely in composition from the rocks in which they are imbedded; this mixture of minerals bears in Cornwall the name of " gossan; " thus, for copper ores, the mixture is more or less rich in ochre, friable quartz, &c., and this " gossan " plays such an important part in the formation of veins, that it is the surest guide that a Cornish miner can have to direct him towards the mineral lode he is seeking for. In the case of copper, this " gossan " is generally above the lode; in tin, generally below, although often stream tin or peroxide of tin is found in the " gossan " itself. For lead ores in Cornwall, the gang is generally a soft blue or dark clay-slate, containing large quantities of alumina and carbonate of lime. In Derbyshire and other parts the gang is generally heavy spar or sulphate of baryta. As to gold, its matrix is quartz, and in North Wales nearly all the veins run in the same direction, viz., from east to west; whilst the iron veins, especially those which are magnetic, run from north to south, and in some instances exactly in the direction of the magnetic poles.

Allow me to draw your attention for a few minutes to a most important discovery which has been made within the last few months, by Bunsen, Edmond Becquerel, and Marcus, of an unforeseen adaptation of terrestrial electricity which results from a slight change of temperature between the various geological beds composing the crust of our planet, and which has received the name of thermo-electricity; up to this period it was admitted that all natural currents of electricity (or dynamic electricity) on the surface of our planet were due to chemical action or molecular changes which were constantly taking place between the various mineral matters composing its surface.

Before attempting to impress your minds with the important part which thermo-electricity must play in the production of the natural electrical currents of the earth, and therefore in the formation of metallic lodes or veins, as above stated, it is necessary that I should say a few words on thermo-electricity itself. If two metallic bars be so soldered together that they compose a closed circuit, a more or less intense current will be produced as often as the temperature varies at the places of junction, the current continuing as long as the difference of temperature is maintained, and this fact can be easily demonstrated if a bar of bismuth and one of copper be soldered together, and their other ends be connected with a copper wire made to pass over a suspended magnetised needle. As long as the temperature of the junction remains unchanged, no current is produced, but as soon as any slight change of temperature occurs at the point of junction, a current of electricity is produced, and the needle is deflected. All metals do not yield the same marked results as bismuth and copper, and investigations have shown that, as with dynamic electricity, metals have different degrees of conductibility; that some may be classed under the name of negative metals, whilst others may be ranged under the head of positive. As the quantity of electricity produced by this means is exceedingly feeble, Nobili conceived the idea of soldering together a number of thermo-electric pairs of copper and bismuth; thus composing a thermo-electric battery, or pile; and Melloni further multiplied the intensity of these currents by an instrument which he called a " thermo-multiplicator;" but, notwithstanding this the quantity of electricity produced by a change of temperature in this manner was so feeble that these currents were considered too insignificant to participate in any way in the production of the natural electricity which was known to exist.

In November last Professor Bunsen published in the " Annales de Poggendorf" a paper in which he showed that thermo-electricity was produced when blades of natural copper pyrites and of pyrolusite (a peroxide of manganese) were heated at their point of junction.

This publication induced Mr. Becquerel to publish a paper in the *Comptes Rendus* of the Academy of Sciences of Paris of last February, in which he showed that sulphur modified in a remarkable degree the thermo-electric power of metals; thus, that sulphide of bismuth was negative to bismuth itself; whilst proto-sulphide of copper was positive with respect to copper, and that the natural copper pyrites was negative to the same metal. Further, he showed that a thermo-electric pair, composed of a bar of copper, and one of protosulphide of copper, would produce, when heated between 32° and 212°, a current ten times as strong as that which would be produced by heating between the same temperatures equal surfaces of copper and bismuth soldered together, and that a more powerful pile still could be produced by forming a pair of proto and bi-sulphides of copper.

Without entering here into the numerous experiments and deductions which Edmond Becquerel draws from his researches, let me at once call your attention to some most valuable results obtained by S. Marcus, of Berlin, who has succeeded in constructing thermo-electrical batteries having a force far exceeding anything that could have been anticipated from thermo-electricity; thus he formed a battery of 25 elements capable of disengaging in a minute 25 cubic inches of hydrogen and oxygen, and of melting a platinum wire 1 millimetre in diameter when placed in the circuit. A battery of 30 elements produced a quantity of electricity sufficient to communicate to an electro-magnet the power of sustaining a weight of 150 lbs.

Mr. Marcus arrives at these results by soldering together long bars of metallic alloys, composed as follows:—

For the positive metal:—

Copper	10 parts
Zinc	6 „
Nickel	6 „

For the negative metal:—

Antimony	12 parts
Zinc	5 „
Bismuth	1 „

These alloys not only give rise to most powerful thermo-electric currents when soldered together, and their point of junction heated, but they are preferable to copper and bismuth, owing to the fact that they undergo no change at a comparatively high temperature as copper does, and do not melt like bismuth. Further, he increased in a marked manner the power of his battery by plunging one end of his soldered bars into cold water whilst their other end was heated by a gas flame, and as no solder could be found capable of resisting such a high temperature, the two bars composing the elements of his battery were united by means of screws.

These facts, together with some others which you will find published in the *Philosophical Magazine* of this year, must give you some idea of the enormous quantity of electricity that must be produced in the crust of our planet by means of thermo-electricity, for we all know the large amount of sulphurets of various metals that enter into the composition of that crust, and there can be no doubt, from the facts above stated, that the electricity so produced must and does contribute, in a marked degree, to the formation of veins and lodes.

My wish was to have drawn your attention to the variety of gases which escape from the craters of volcanoes when in activity, as well as from the secondary outlets, called "fumerolles," as much information has been added to our knowledge on these phenomena of late years by M. Charles St. Claire Deville and M. Fouqué since the valuable researches of Professor Daubeny on these phenomena; still, I cannot refrain from calling your attention to several tables which I have hung round this room, and which illustrate the great variety of gases that escape from the crater, as well as from the fumerolles which surround it. From the crater escapes hydrochloric and sulphurous acid, volatile chlorides, and aqueous vapour; at a short distance from it hydrochloric acid appears to cease, and sulphurous acid to predominate; thus in 100 parts of gas he found—

Sulphurous acid	24·5	
Oxygen	14·5	
Nitrogen	61·0	
		100·0

At a further distance he found sulphuretted hydrogen and carbonic acid, varying from 0·8 per cent. to 28 per cent.; oxygen, 8·2 per cent.; and nitrogen, 90 per cent. In another case, 14·9 per cent. of oxygen, and 56·9 per cent. of nitrogen; and as he still proceeded further from the centre of activity, the sulphuretted hydrogen and sulphurous acid disappeared, and were replaced by carbonic acid, and lastly by a mixture of light carburetted hydrogen and carbonic acid, as this table illustrates:—

	Santa Venerina.	San Biagio.	Paterno.	Valice.	Girgenti.
Carbonic acid	3·13	74·99	95·35	93·49	1·65
Oxygen	1·18	2·78	0·58	0·68	0·69
Nitrogen	22·15	19·47	2·94	5·14	3·74
Carb. hydrogen	71·76	3·77	1·12	1·45	87·23
Hydrogen	3·70	0·99	0·50	0·43	5·74
Sulphuretted hydrogen	traces.	...	...	...	...

Proceedings of Institutions.

METROPOLITAN ADULT EDUCATION ASSOCIATION.—Evening classes for males and females have been organised in Holy Trinity Schools, Hoxton, under the presidency of the Rev. T. W. Fowle. A numerously attended public meeting was held on Oct. 31, in the school-rooms, when the class system and scheme of examinations promoted by the Association in connection with the Society of Arts were explained by the Rev. G. B. Macilwain, Hon. Sec., and Mr. H. H. Sales, Visiting Officer to the Society of Arts. There is good prospect of the newly formed classes forming the centre of other similar classes in the district.

Fine Arts.

HORACE VERNET'S TOMB.—M. Constant Dufeux has just completed the tomb of the painter, Horace Vernet, in *Pere la Chaise*. It consists of a large block of granite, without any ornament, upon which is placed a slab of white marble in the form of a Latin cross. The only emblems on the tomb are a drapery, studded with stars, which surmount the cross, and palette and brushes.

Commerce.

GREEN TEA.—Messrs. Travers give the following account of the production of this kind of tea:—"Some, perhaps, of our readers may not be aware of the fact that the tea shrub is a single species, and that from the same tree black or green tea might be made, indifferently; though for commercial purposes it has been found more convenient to confine the manufacture of particular teas to particular districts. The difference between the two, black and green, depends solely on the manipulation and the processes to which the leaves are subjected during the period of manufacture. In the case of the latter, those leaves which are intended to be converted into green teas are roasted almost immediately after they are gathered, and then quickly dried off after they have undergone the rolling process; the colour by this method becomes fixed, and there is no danger of any subsequent change. In the case of the black tea, the leaves are opened flat, and allowed to lie exposed for ten or twelve hours before being roasted; after roasting they are again exposed to the air in a soft and moist state, and finally they are dried slowly over charcoal fires. That this difference in colour is effected solely by the difference in manufacture is proved by subsequent observations made by Mr. Warrington at Apothecaries' Hall. Whilst engaged in the exsiccation of certain medicinal herbs, he found that the plants, but more especially those which were nitrogenous, brought from the country by the collectors, were on their first arrival of a bright green colour; but that when delayed too long on their journey, or confined for too long a period after being dried, they had entirely lost the bright green, and assumed a blackish-brown in its place. But it is not sufficient for the English consumer that the natural green only of the tea leaf should be there; the leaves before they are allowed to please the palate must pass the more exacting ordeal of the eye. They must be uniform in their appearance, and of a particular hue. As this effect can only be produced by the employment of colouring matter, a mixture compounded of gypsum and Prussian blue, is laid on the leaves, during the last process of roasting. This adulteration the Chinese do not hesitate to carry out on a systematic plan, and on a most extensive scale, and the practice, so far from diminishing, is even extending to the Northern parts of China. 'During this part of the operation,' says Mr. Fortune, in his description of the process, 'the hands of the workmen were quite blue. I could not help thinking that if any green tea drinkers had been present during the operation, their taste would have been corrected, and, I may be allowed to add, improved. It seems perfectly ridiculous that a civilised peeple should prefer these dyed teas to those of a natural green. No wonder that the Chinese consider the natives of the West to be a race of 'barbarians.'' Mr. Fortune says that half-a-pound of paint or colouring material is mixed with each hundred pounds of green tea. The Chinese readily acknowledge the superiority of green, uncoloured, but plead in excuse for their adulterations the wilful preference of the foreigner; we need hardly add that they are far too sensible to touch these dyed teas themselves."

Cotton.—From letters recently read before the Executive Committee of the Cotton Supply Association, it appears that the planting of the cotton seed has been attended with complete success in Jamaica, Tobago, Upolu (Samoa), and King William's Town (South Africa), but the most remarkable proof of the success attending the efforts of the society to promote the growth of cotton is to be found in the fact that, from the accidental reception of a handful of Sea Island cotton seed in the year 1863, between thirty and forty acres in the neighbourhood of Naples are now planted with it, from which a crop of about 40,000lbs. of seed-cotton, equivalent to a yield of 10,000 lbs. clean cotton, is expected this year. The handful of seed planted in 1863 produced about 80 lbs. of uncleaned; and with the seed of this quantity two acres and a-half were sown in 1864, which yielded a bale of 750 lbs. of clean cotton. At a time when New Orleans sold at 17d. per lb. and fair broach was worth 14d., this amount of Naples cotton realized as much as 29d. in Manchester. At Upolu, one of the Samoan group of islands, the Consul planted about seventy acres, and it was expected that there would be as many as 400 acres under cultivation before the close of the year. The whole of the Samoan islands are reported to be extremely suitable to the cultivation of cotton; but the implements in use there are of the rudest description, and the natives themselves are wanting in industry. Some New Orleans seed sent to Kurnaul, in the Madras Presidency, arrived too late in the season, so that the crop turned out a failure.

Colonies.

Hobart Town Statistics.—The estimated population of Tasmania on 31st December, 1864, was 93,307. The arrivals during the year are estimated at 3,711, and births 3,031; but from this must be deducted, departures 3,521, and deaths, 1,433—total, 4,954; leaving an increase on last year of 1,788. The births show a total increase of 33, and the deaths 15, on those of the previous year. The marriages registered were 698, precisely the same number as in 1863. During 1864, 118 immigrants were introduced—53 males and 65 females—the average cost to the colony per statute adult being £9 12s. 9d. Only 6 of the aboriginal inhabitants remain, 1 man and 5 women. They are located at Oyster Cove, and the cost of superintendence and maintenance last year was £522. The value of the imports and exports from Hobart Town was:—

	Imports.	Exports.
To United Kingdom	£252,590	.... £251,285
To British Colonies	296,425	 255,606
	£549,015	£506,891

The value of imports and exports from Launceston was:—

	Imports.	Exports.
From United Kingdom......	£95,696	.... £170,236
From British Colonies	263,554	 297,603
	£363,250	£467,839

During the past year 140,108 acres of country lots were sold by the Crown for £108,250, an average of 15s. 5½d. per acre. During the same period town and suburban allotments, comprising 1,273 acres, were sold for £7,546, being an average of £5 18s. 6d. per acre. The total number of acres in cultivation was 252,164, and 5,527 acres of new land were broken up during the year. Of this cultivated land, 60,186 acres were sown with wheat, yielding 839,501 bushels; 6,320 acres with barley, yielding 123,320 bushels; 40,987 acres with oats, yielding 995,382 bushels; 30,992 acres with colonial hay, yielding 35,210 tons; 127 acres with tobacco, yielding 242,778 lbs. 128,784 bushels of apples, and 13,840 bushels of pears, were grown last year, against 168,114 of the former and 25,800 of the latter the previous year. The present stock of live stock is:—Horses, 22,000; horned cattle, 89,801; sheep, 1,736,540; goats, 2,393; mules and asses, 13; pigs, 50,380.

Graving Dock for Melbourne.—The total length of this dock will 250 ft., and breadth 94 ft. at the top and 50 ft. at bottom. The depth will be sufficient to allow of the entrance of vessels drawing 25 ft. of water, which will render the dock available for vessels of the largest size that visit Hobson's Bay. The total cost is estimated at £100,000. A fair beginning has thus been made towards the dry dock accommodation which has for years been the great drawback to the Port of Melbourne, vessels of large size if wanted to be overhauled or repaired having to go to Sydney.

Telegraphing in New Zealand.—An order has been sent to England for a supply of thirty or forty miles of cable for connecting the northern and middle islands. The route had been surveyed by Mr. Balfour, and the cable would cost altogether £20,000—£10,000 for the first cost, and £10,000 bringing it out, laying down, and other incidental expenses.

Publications Issued.

The Life, Times, and Labours of the Marquis of Worcester, to which is added a reprint of the Century of Inventions. By Henry Dircks. (*Quaritch.*)—The origin of the steam-engine has never yet been satisfactorily elucidated. Many claimants have been put forth for the honour, and Mr. Dircks, in writing the life of the Marquis of Worcester, advocates his claims to be considered as the originator of that source of national power and wealth. Mr. Dircks has had placed at his disposal by the Duke of Beaufort, the present representative of the Marquis's family, a number of original manuscripts and documents not hitherto published.

Half-hours of French Translation. By Alphonse Mariette, M.A., Professor of the French Language and Literature at King's College, London. (*Williams and Norgate.*)—The first part of this work consists of a well-chosen series of extracts from good English writers, very various in style, and in the form of idiom employed. The range of selection is over the whole of the wide field of English prose, between the essays of Lord Bacon and those of contemporary journalists. The choice of each extract has been founded not upon its merit more than its convertibility into French. Every passage may be so translated that a good translation shall seem to contain not the words only but the thoughts also, and some one of the moods of a Frenchman. In foot-notes, carefully appended to each passage, the labour of the pupil is lightened by the supply of fragments of translation where the two languages differ in idiom. In the second part of the book, Professor Mariette has translated from contemporary French authors choice illustrations of the French of to-day, and has so translated them that they may by a skilful hand be faithfully turned into French. In the extracts from French writers there is the same regard paid to variety of tone; and the student who throughout the first part of the book is speaking the thoughts of his own land in the language of a neighbour, in the second part of the book, when he does not mistranslate, is actually writing French thoughts in the Frenchman's way. A key to the above, by the same author, is also published.

Forthcoming Publications.

The Record and Descriptive Catalogue of the Dublin International Exhibition of 1865, by Henry Parkinson, Secretary and Comptroller; and P. L. Simmonds, Colonial Superintendent. (*Dublin, John Falconer.*) This work will contain all the official documents, statistical data, and descriptive information of the rise, progress, and results of the exhibition and winter garden building; with details of the articles exhibited, and the advance made in Irish industries since 1853, and is published under the sanction of the Executive Committee, and dedicated to His Grace the Duke of Leinster, B. L. Guinness, Esq., M.P., and Gilbert Sanders, Esq.

Notes.

Reading Industrial Exhibition.—The Industrial Exhibition, and collection of fine art treasures from the mansions of Berkshire, held at the Town-hall, Reading, since the 13th of September, closed on Monday, the 30th October, when the medals and money prizes were distributed by the Right Hon. the Earl of Carnarvon. The undertaking has been carried out with spirit, and been attended with great success, nearly 70,000 persons having visited the exhibition, and the receipts amounting to £1,800. It is estimated that the expenditure will amount to £1,300, of which sum £300 were set aside for money prizes, medals, and certificates.

Middle-class Education in the City.—A proposal has been made by the Rev. William Rogers, M.A., rector of St. Botolph, Bishopsgate, a member of the Council of the Society of Arts, for an extension of the means of education in the city of London, so as to meet the confessed wants of a great class there who are at present without any public provision of the kind. The educational wants of the poor are met by the ward and other schools; but above these is a large middle-class, composed of tradesmen and people employed in the City, who cannot well send their children to the Ward or National Schools, and who are debarred by various circumstances from availing themselves of the great city schools. The recipients of the endowed charities in city parishes are yearly diminishing in number, but the funds are increasing. It is proposed that a combination of the parishes should be brought about, and from such surplus funds a system of education should be established for the children of parents who cannot afford to pay more than say £1 per quarter for their education. The contributing parishes to be represented upon the board of management of the schools, and the children of parents who either reside or are employed in such parishes to have a prior claim of admission to the advantages. It is thought that Finsbury would be a convenient and desirable situation for a school of this nature.

Musical Education in Paris.—The municipal authorities of Paris have this month established courses of gratuitous instruction in singing in the municipal schools of eighteen of the arrondisements of the city, one, two, or three courses in each, making in all twenty-eight classes; two arrondisements only are now without gratuitous vocal instruction.

Improved Railway Accommodation.—A novelty has been introduced in the railway between St. Petersburgh and Moscow; carriages, designated as *wagons hôtels*, containing a saloon, and also closets with comfortable beds, have been placed on the line by a speculator, who charges two roubles extra to each passenger who avails himself of the new carriages, in addition to the ordinary passenger fare charged by the company.

Consumption of Alimentary Matters in France.—M. Payen, the well-known chemist, gives the following statistics, which are said to be authentic. France consumes annually, in round numbers, about 700,000,000 gallons of milk, of which Paris takes nearly one-third; nearly 120,000 tons of cheese of all kinds, the share of Paris being only 5,000 tons; 290,000 tons of sugar, Paris consuming 20,000 tons; nearly 38,000 tons of coffee, Paris using 4,500 tons; 20,000,000 gallons of beer, of which Paris drinks an entire sixth. The total quantity of wine produced in France is set down at nearly a thousand millions of gallons, and valued at twenty-two millions sterling, or about fivepence per gallon.

Correspondence.

Passage Across La Manche.—Sir,—Can anything be more barbarous and cruel than the arrangements which at present the public tolerate for crossing the 22 miles of sea between France and England? On both sides of the channel the railways afford comfortable shelter in stations and carriages, with rugs, and carpets, and *chauffe-pieds;* but as soon as you leave the carriages at the termini you are sent adrift in hail, rain, snow, and cold on the steamer, and are much less cared for than your baggage. If the day be wet—and throughout more than six months of the year this is the case—your feet are soaked through in descending the well-watered steps from Dover-pier to the steamer or across the pavement at Calais. When you arrive on board you have the choice between the cabin, detestably close and stinking, filled with human beings senselessly prostrate and sick, or the open deck, with the certainty of being soaked through by the rain and the spray washing over the boat from the head of the vessel to the man at the wheel. There is no shelter whatever afforded by these little swift steamers, which rush through the water, and nothing can be had for covering except the stiff, rough, wet tarpaulin jackets of the sailors, which you don't get till you are already half-wetted through. It is persecuting enough to a hale man not given to sea-sickness, but to women and those who faint when descending to the cabin, the arrangements, or rather utter absence of arrangements, are cruel and excessively dangerous, especially for invalids. Can nothing be done in this age to ameliorate the sufferings of those dreadful two hours? To obtain a swift passage must, at least, an average of 200 persons every day in the year be thus persecuted? I don't believe it at all. It is not my province to suggest the remedies for obtaining shelter on the deck, which even the present boats might, I conceive, adopt. But here is a proposal, at least as a temporary palliative, until something better can be done. Let the railway companies offer to each passenger, at a proper charge, the use of a waterproof *capôte*, covering the head and shoulders, a long, warm, cloth-lined macintosh-cloak — say about 7ft. long—with a pair of waterproof over-boots, and an air cushion for sitting upon on the wet seats. They might be so made as effectually to keep the wearer dry from the rain and sea. They should be provided for the passenger either at starting or at the last station before crossing. If necessary, he might make a deposit for their value, which would be returned upon giving up the articles. It may be said every one can do this for himself. Certainly he could, and no doubt would if he had to cross frequently; but twice a year is as much as most travellers do, and they don't make special preparations. These articles would enable both women and men to stay on deck if they preferred it, and would prevent that soaking which afflicted my wife, two ladies, and your humble servant last week, entailing upon most of the parties colds and coughs which may chance to last all the winter, and largely increase the doctor's bill at Christmas. These remarks apply equally to the passages to Ostend and elsewhere. The College of Physicians, the Institute of Civil Engineers, and the Society of Arts should all agitate respectively for some efficient remedies for the present state of things; and as Parliament descends to regulate London cabs, it might as well, perhaps, direct the Board of Trade to look to the small fry of sea steamers and their discomforts.—I am, Sir, yours, &c., FELIX SUMMERLY.

Oct. 26.

MEETINGS FOR THE ENSUING WEEK.

MON. ...Medical, 8. General Meeting for Alteration and Revision of Laws. 1. Dr. Althaus, "On Degeneration of the Posterior Column of the Spinal Cord." 2. Mr. Leonard Clark, F.R.S., "On the same subject."

TUES. ...Ethnological, 8. 1. "Report on the Ethnological Papers read at the Meeting of the British Association in Birmingham." 2. Captain L. Wildman, R.N., "Notes on the Manners and Customs of the People about Little Popo, on Bight of Benin." 3, Dr. Cullin, "On the Darien Indians."

WED. ...Geological, 8. 1. Mr. R. A. C. Godwin-Austen, F.R.S., "On the Submarine Forest-beds in Porlock Bay. 2. Rev. R. Boog Watson, "On the Marine Origin of the Parallel Roads of Glen Roy."

Patents.

From Commissioners of Patents Journal, October 27th.

GRANTS OF PROVISIONAL PROTECTION.

Aerated wafers—1774—W. S. Parfitt.
Air, obtaining motive power by expansion of—2600—W. E. Gedge.
Alarms, apparatus for sounding—1898—J. H. Wray.
Bedsteads, &c.—2656—J. L. Hancock.
Blast furnaces—2528—S. C. Salisbury.
Block matches—2690—J. W. Truman and H. Lovi.
Bolts, &c.—2618—F. P. Warren.
Boots and shoes, elastic fronts, &c., for—2640—M. Cartwright.
Breech-loading fire-arms, cartridges for—2542—J. and F. J. Jones.
Breech-loading guns, projectiles, and cartridges—2512—E. Lindner.
Calender bowls, and cylinders or rollers—2636—W. Mather.
Capstans—2576—W. D. Grimshaw.
Carbonic acid gas—2660—A. J. Mott.
Carding engines, grinding cards for—2518—S. Faulkner.
Carriages, wheels for—2668—J. L. Hancock.
Casks for oil—2500—J. H. Pinckvoss.
Cast iron and steel—2456—N. Korshunoff.
Cattle, food for—2514—R. Willacy.
Chair, reclining—2504—G. Davies.
Chairs, folding—2678—G. Davies.
Clod crushers and chain harrows—2634—W. C. Cambridge.
Clothes wringing machines—2336—T. D. Stetson.
Coating iron and steel with gold, &c.—2592—J. B. Thompson.
Copper—2662—W. Clark.
Cornices, &c., composition for forming—2638—W. Barwick.
Cotton seeds, cleaning—2554—J. C. Stovin.
Crucibles, &c., moulding—2464—R. A. Brooman.
Danger, telegraphs for indicating—2584—C, H. Mellor.
Doors, fasteners for—2566—C. F. Gerald.
Dyeing—2506—J. de Weweirne, jun., and A. Verschaffelt.
File-cutting machines—2548—J. Dodge.
Fire-escape—1666—W. E. Gedge.
Fire-proof floors and ceilings—2594—J. Homan.
Fire-proof floors for buildings—2578—J. Cunningham.
Flax, &c., machines for winding—2588—J. Kirby.
Folding chairs—2200—G. T. Bousfield.
Furnaces, consuming smoke in—2382—C. Worsam.
Gas—2620—J. Crutchett.
Gas meters—2372—W. Esson.
Grain, cisterns or chambers for steeping—2492—C. E. Davis.
Hides, tanning—2591—W. Harris.
Horses, shoeing—2496—W. E. Newton.
Hydro-carbon, casks for containing—2644—G. Marshall.
Iron—2448—W. Unwin.
Leather, &c., perforating—2556—E. Marsland and P. Williams.
Life-rafts—2510—J. W. Hurst.
Linen buttons—2066—W. Aston.
Liquids, evaporating and distilling—2590—T. Campbell.
Liquids, heating and cooling—2494—I. Smith and W. F. Batho.
Liquids, raising—2632—J. U. Bastier.
Locks and latches—2484—C. Price.
Lozenges, &c.—2534—C. J. Tinker.
Meat, treating and obtaining products from—2558—R. Morson.
Mechanical propelling screw toy—2572—L. A. I. Daumesnil.
Mill stones—2692—W. H. Parker.
Motive power, obtaining—2020—A. Sleigh.
Musical reed instruments—2541—F. Tolhausen.
Oil from coal, &c., extracting—2544—A. Craig.
Paper—2404—S. Trotman.
Pencils and pencil cases—2486—M. Nopitsch.
Photography, preparing paper, &c., for—2648—J. de W. Brinckerhoff.
Pianofortes—2540—E. Farr, W. Tarr, and I. Gregory.
Pianofortes—2562—B. Johnson.
Railway signals—2526—H. G. James.
Railway trains, signals for—2586—J. Hancock.
Railway wheels, tyres for—2654—W. J. Armitage, F. Wooler, and J. Hodgson.
Saddles—2688—T. Jones and E. K. Mason.
Saucepans, &c., sheet metal handles for—2228—J. Fallows.
Screws, cutting—2652—J. Tangye.
Serpents, &c., fire-work producing the forms of—2293—F. Tolhausen.
Sewing machines—2498—R. A. Brooman.
Sewing machines—2666—J. B. Robertson.
Sheet metals, fixing—2522—J. W. Tyler.
Ships' waterclosets—2546—E. W. de Rusett and R. F. Dale.
Ships, cleansing the bottoms of—2589—T. M. Gisborne.
Silk, &c., dyeing and printing—2536—R. A. Brooman.
Skates, fixing—2642—W. May.
Skins, hides, or leather, making waterproof—2516—J. W. M. Miller.
Specific gravities and the bulk of solids, ascertaining—2490—A. M. Bennett.
Spinning, bobbins used in—2368—J. K. Hoyt.
Steam boilers, tubular—2260—J. Lake.
Steam engines—2502—W. E. Gedge.
Steam, generating—2604—J. Sturgeon.
Steam generators—2610—J. H. Johnson.
Submarine lamps—2458—J. S. Staines.
Submarine telegraph cables—2530—H. A. Bonneville.
Submarine telegraphy—2612—J. F. Wiles.
Telegraphic cables, laying—2570—F. W. Gardiner.
Tompions for ordnance, and stoppers for bottles—2650—W. E. Newton.
Tooth-powder, receptacle for—2470—A. Farr.
Turning lathe, chucks for—2680—R. Burley.
Ventilating spring mattress—2511—J. E. Townshend.
Vessels, propelling—2418—R. Atkin.
Washing liquors—2582—J. Roddy.
Water, liquid compound for purifying—2646—R. A. Brooman.
Water, purifying and preserving—2674—C. G. Lenk.
Weaving, looms for—2395—J. Edmondson.
Weaving, looms for—2596—P. Todd.
Weaving, looms for—2672—E. Lord.
Weights, raising—2560—H. A. Dufrene.
Whistles, signalling by means of combined—2575—W. A. Martin.
Woollen fabrics, waterproofing—2568—H. F. Smith.
Yarns or threads, spinning, &c.—2538—W. E. Newton.

INVENTION WITH COMPLETE SPECIFICATION FILED.

Sliding surfaces, obtaining—2729—L. D. Girard.

PATENTS SEALED.

1197. L. W. Broadwell.
1198. T. White.
1203. W. Leatham.

From Commissioners of Patents Journal, October 31st.

PATENTS SEALED.

1208. H. Bessemer.
1210. C. E. Herpst.
1213. J. C. Davis.
1215. M. W. Ruthven.
1216. W. E. Wiley.
1224. R. Fenner.
1227. F. Wise.
1229. T. Allcock.
1230. C. W. Siemens.
1231. J. Catillon.
1232. J. B. Lavanchy.
1234. E. T. Read and J. B. Fyfe.
1238. T. W. Roe.
1243. G. Josse.
1244. E. G. Smith.
1245. W. F. Stanley.
1247. G. Redrup.
1248. F. Caldwell.
1249. J. Hampton.
1250. W. Roberts.
1251. J. Lilley.
1252. A. Mackie, H. Garside, and J. Salmon.
1255. W. Henderson.
1257. T. J. Mayall.
1260. J. Mitchell.
1261. J. Wadsworth, H. Dussett, and J. McMurdo.
1262. J. McGlashan.
1287. W. Jackson.
1291. D. Adamson.
1300. J. J. Révy.
1303. S. Pokutynski and M. Mycielski.
1311. G. Mountford and E. Worroll.
1314. E. L. Girard.
1317. J. Hesford.
1390. C. Varley and S. A. Varley.
1440. H. E. Newton.
1466. W. Settle.
1514. W. E. Newton.
1544. J. Kennedy.
2285. J. Pilkington.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

2863. A. J. F. Vigneulle-Brepson.
2894. A. Peek.
2963. J. Musgrave.
2880. T. G. Ghislin.
2891. J. J. Ridge.
2887. F. Lipscombe.
2890. F. L. H. W. Bunger.
2892. P. E. Placet.
2900. E. Tathum and A. Tatham.
2931. P. Giffard.
2946. G. Speight.
2908. A. Shanks and F. Kohn.
2922. F. L. Stott.
2927. F. Gregory.
2937. W. R. Bowditch.
2951. J. G. Marshall.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

2409. W. Munro.
2406. A. Heywood.
2411. W. Hall and A. Wells.